* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal equipment which comes to use a polarizing plate.
[0002]
[Description of the Prior Art] It has come to be required that the viewing-angle property liquid crystal equipment was widely used as displays, such as various OA equipment, such as a liquid crystal television and a note type personal computer, and ** excelled [property] in contrast sufficient at the time of a display should be shown.
[0003] As a factor which determines the viewing-angle property of liquid crystal equipment, it is known that a polarizing plate also has a viewing-angle property besides the viewing-angle property of the liquid crystal device itself.
[0004] As shown in drawing 16 , the viewing-angle property of the transmitted light (leakage light) when polarizing plates 161a and 161b have been arranged to the crossed Nicol is shown in drawing 17 . In drawing 16 , arrow heads 162a and 162b show the transparency shaft of polarizing plates 161a and 161b. drawing 17 -- the magnitude of leakage light -- a contour line -- a table -- it is a thing the bottom. Thus, such optical big leakage is produced that it approaches in the 45-degree direction to transparency shaft 162a of a polarizing plate, and the direction of 162b.
[0005] As this cause, change of the direction of two transparency shafts 162a and 162b with which a polarizing plate intersects perpendicularly is cited. As shown in drawing 18 , the direction of transparency shaft 162a of a polarizing plate is maintained in a perpendicular direction (a) and the direction (b) leaned 45 degrees, and the relation of the transparency shaft orientations with which it intersects perpendicularly when leaning at the include angle theta from [of the screen] a normal, respectively is shown. When transparency shaft 162a is the direction of a vertical, even if the include angle between transparency shaft 162a of two polarizing plates and 162b leans theta how many times, 90 degrees is maintained and it crosses. On the other hand, when 45 degrees is leaned, the include angle between transparency shafts becomes larger than 90 degrees as theta becomes large. That is, if the screen is leaned, the orthogonality relation of the transparency shaft of two polarizing plates will collapse, and, thereby, optical leakage will arise.
[0006] As a means to solve such a problem, as it was in "a television institute besides Yamagishi and Watabe, IDY 90-47, P.35", and JP,5-45520,A, the approach using the birefringence effectiveness of a phase contrast film was considered.
[0007]
[Problem(s) to be Solved by the Invention] The object of this invention is to compensate change of two transparency shaft orientations shaft orientations and a polarizing plate cross at right angles using the effectiveness of refraction of a polarizer not using the above mentioned phase contrast film, and is to offer the liquid crystal display which has improved the viewing-angle property of contrast using the polarizing plate which has improved the viewing-angle property of a polarization condition.

[0008]
[Means for Solving the Problem] This invention is liquid crystal equipment which has the liquid crystal device which comes to pinch liquid crystal between the substrates of a couple, and the polarizing plate prepared in the outside of one [at least] substrate of this liquid crystal device, and said polarizing plate is the refractive index n0 of transparency shaft orientations. It is liquid crystal equipment characterized by having a polarizer exceeding 1.6.
[0009] In this invention, the polarizer which has direction-refractive indexes, such as abbreviation, and the polarizer which has an optically uniaxial or optically biaxial birefringence can be used as the above-mentioned polarizer. Moreover, when using the polarizer which has this birefringence, it is desirable to constitute so that the refractive index of the transparency shaft orientations of a polarizer may become larger than the refractive index of absorption shaft orientations.
[0010] The compensation approach of change of the transparency shaft orientations of the polarizing plate in the case of the oblique incidence in the polarizing plate concerning this invention is explained. The incident angle of light and the relation of the polarization direction which carry out incidence to a polarizing plate at drawing 19 are shown. 191 is refractive-index n=np here. It is a polarizing plate, and if the refractive index of the air before and behind theta 3 and a polarizing plate is set [the incident angle to the polarizing plate 191 of light / the angle of refraction in theta 1 and a polarizing plate 191] to n= 1.0 for theta 2 and the outgoing radiation angle from a polarizing plate 191, it will be set to sintheta1 =np sintheta2 =sintheta3 from Fresnel's formula. Refractive index np of this formula to the polarizing plate 191 When it becomes large, it is theta 1 [big]. Even when carrying out oblique incidence, it turns out that the light which passes through the inside of a polarizing plate 191 becomes close to vertical incidence, and change of the transparency shaft orientations by oblique incidence becomes small.
[0011] Therefore, it excels in the viewing-angle property of a polarization condition, and liquid crystal equipment excellent in the viewing-angle property of contrast can consist of polarizing plates with the refractive index of polarization shaft orientations high at least by using this polarizing plate.
[0012]
[Embodiment of the Invention] The polarizing plate used for this invention pastes up a transparence protection film on the polarizer which has a high refractive index. The sectional view of the example is shown in drawing 1 . Among drawing, as for a polarizer, 2a, and 2b, one is an adhesives layer, and 3a and 3b are transparence protection films. A transparence protection film is prepared in one side, even if there are few polarizers 1, and as shown in drawing 1 if needed, it is prepared in both sides.
[0013] As for the usual polarizer, the thing of the high refractive index to which it exceeds 1.6 in this invention although a refractive index is about 1.5 is used. Although 1.7 or more and further 1.75 or more are preferably desirable, since a surface echo will become large if a refractive index becomes high, according to the viewing-angle property acquired, it chooses suitably. It can be suitably used to about 2.0 refractive index. Moreover, in this invention, it is desirable in the case of the polarizer with which a refractive index can also use the polarizer which has optically uniaxial and the optically biaxial birefringence other than direction-polarizers, such as abbreviation, and has this birefringence, to constitute from a viewpoint on manufacture and a property so that the refractive index of the transparency shaft orientations of a polarizer may become larger than the refractive index of absorption shaft orientations.
[0014] The film which consists of what processed and extended the film which consists of a hydrophilic macromolecule like polyvinyl alcohol, partial formal-ized polyvinyl alcohol, and an ethylene-vinylacetate copolymer system partial saponification film as a polarizer 1 used for this invention with iodine and/or a dichroic color, a thing to which a plastic film like a polyvinyl chloride was processed and orientation of the polyene was carried out is used.
[0015] The refractive index and the molecular structure of a high refractive-index macromolecule are connected by the formula of Lorentz-Lorentz, and the relation of a refractive index (n), molecular refraction (R), and molecular volume (V) is expressed with the following formulas.
[0016]
$(n-1) / (n+2) = [R] / V = phi$ -- (1)

n= [(2phi+1) /(1-phi)] 1/2 -- (2)
[0017] Among these, [R] is called for as the sum of atomic refraction and the increment in joint voice. Moreover, about a known polymer, V is called for by [the formula weight of a repeat unit] / consistency. From this formula, greatly, [R] gives a high refractive index, so that V is small, and the monomer for casting polymerizations which specifically used halogen-containing aromatic series structure and a sulfur compound is mentioned. A refractive index will become high if a component with high polarizability is included like the halogen atom except a fluorine, or a ring. Conversely, that the atomic refraction of a fluorine atom is small and increasing molecular volume can contribute, and the polymer containing fluorine atoms, such as polytetrafluoroethylene of the form where H of polyethylene was permuted by F, can make a refractive index low.
[0018] As transparence protection films 3a and 3b used in this invention, a polycarbonate, triacetyl cellulose, polymethylmethacrylate, polyether sulphone, polyethylene terephthalate, polyarylate, and polyimide are begun, for example, and a polyvinyl alcohol system, polystyrene, etc. are not limited especially about the class of macromolecule which forms a film. Moreover, what is necessary is just to take approaches, such as carrying out drawing processing of the high polymer film with one shaft thru/or two shafts, etc., in order to give birefringence to the transparence protection films 3a and 3b.
[0019] Although not limited especially about the class of adhesives on which the polarizer 1 used in this invention and the transparence protection films 3a and 3b are pasted up, what does not require an elevated-temperature process in the case of hardening or desiccation is desirable, and what does not require hardening processing or the drying time of long duration is more desirable than the point of change prevention of the optical property of a polarizer 1 or the transparence protection films 3a and 3b.
[0020] The liquid crystal equipment of this invention arranges the above-mentioned polarizing plate on one side of a liquid crystal device, or both sides. The mimetic diagram of the cross section of this liquid crystal equipment is illustrated to drawing 2 . It is the polarizing plate which 26a and 26b described above among drawing, and, for substrates, such as glass, and 22a and 22b, an electrode, and 23a and 23b of the orientation film and 24 is [21a and 21b / 25] liquid crystal devices in a liquid crystal layer.
[0021] For example, the SSFLC mold using the Twisted Nematic mold using the nematic liquid crystal as a liquid crystal layer 24 used in this invention, a super twisted nematic type, an in plane switching mold, chiral smectic liquid crystal, especially a ferroelectric liquid crystal etc. is mentioned. Moreover, the nematic liquid crystal which has a bistability may be used. The principle of the component using this liquid crystal is indicated by JP,6-230751,A etc. For example, it is constituted using what added the optical-activity agent (trade name: S811, Merck Co. make) to KN-4000 (a trade name, Chisso Corp. make) of marketing, adjusted the helical pitch of a nematic liquid crystal to 3.6 micrometers, applied polyimide to 100nm thickness as orientation film as a cel, carried out rubbing processing so that it might become anti-parallel mutually, and set the cel gap to 2.0 micrometers.
[0022]
[Example]
The glass substrate of the couple which formed the ITO film with a thickness [by the spatter] of 70nm as a [example 1] transparent electrode was prepared, and the spin coat of the NMP(N-methyl pyrrolidone):n-BC (n-butyl cellosolve) mixed solution of the polyamic acid (trade name: LP-64, Toray Industries, Inc. make) which is the precursor of polyimide was carried out on one ITO film. The spreading solution was adjusted so that it might become the mixed solvent of NMP:n-BC=2:1 with 1 % of the weight about LP-64, and spin conditions were performed for 20 seconds by 45 revolutions per second. After performing solvent desiccation for 5 minutes for this substrate in 80-degree C oven, heating baking of 1 hour was performed and imide-ized in 200-degree C oven. The obtained polyimide film was about 10nm in thickness, carried out rubbing processing of this film, and used it as the orientation film. Rubbing processing twisted the film made of nylon around the roller with a diameter of 10cm, is 10mm/second in 0.4mm of pushing of cloth to 16.7 revolutions per second and the polyimide film, and feed rate of a substrate, and carried out rubbing in the same direction twice (one way). Then, spin spreading of the IPA (isopropyl alcohol) solution which made the front face of this substrate distribute the silica bead of 2.0 micrometers of mean diameters at 0.008 % of the weight is carried out

the condition for 25 revolutions per second and 10 seconds, and it is 2 300 distributed consistencies/mm. The bead spacer of extent was sprinkled.
[0023] On the ITO film of a substrate, another substrate of the pair opposite side carried out spin spreading of the 0.5-% of the weight ethyl alcohol solution of a silane coupling agent (ODS-E) the condition for 45 revolutions per second and 20 seconds, and carried out vertical orientation processing. Then, coating of the sealing compound of a heat-curing mold was carried out by printing on this substrate.
[0024] In this way, heat curing of the two obtained substrates was carried out for 90 minutes in lamination and 150-degree C oven face to face, and they were used as the cel.
[0025] 30-degree C spontaneous polarization injected into the above-mentioned cel the ferroelectric liquid crystal 5 degrees and whose tilt angle theta 26 nC/cm2 and 30 degrees C layer angle-of-inclination delta are 22 degrees. In addition, the measuring method of these properties is shown below.
[0026] (Measuring method of spontaneous polarization) Others [Miyasato / K.] "the direct measurement approach of the spontaneous polarization of the ferroelectric liquid crystal by the chopping sea" (Japanese Journal of Applied Physics) [22, 10 No. (661) 1983,] ["Direct Method with Triangular] Waves for Measuring Spontaneous Polarization in Ferroelectric Liquid Crystal" as described by KMiyasato et By al. (Jap.J.Appl.Phys.22.No.10, L661 (1983)) It measured.
[0027] (Measuring method of layer angle-of-inclination delta) Fundamentally, it measured by the approach (JapanDisplay '86, Sep.30-Oct.2, 1986, 456-458) performed by Clerks and Lagerwall, or the approach (J. J.A.P.27(5) (1988)725-728) of Ochi and others and the same approach. The measuring device used the micro sheet (80 micrometers) by Corning, Inc. for the substrate in order to reduce absorption of the X-ray to the glass substrate of a liquid crystal cell using revolution cathode method X-ray diffractometer (product made from MAC Science).
[0028] (Measuring method of tilt angle theta) The 1st extinction position (location where permeability becomes the lowest) and 2nd extinction position are searched for, detecting an optical response by photograph mull (product made from Hamamatsu Photonics) at the same time it makes a polarizing plate and parallel rotate the liquid crystal device arranged under a rectangular cross Nicol's prism in the meantime, impressing AC (**30-**50V and 1-100Hz) (alternating current) through an electrode between the vertical substrates of a liquid crystal device. And one half of the include angles from the 1st extinction position at this time to the 2nd extinction position is set to tilt angle theta.
[0029] In this example, the transparence protection film which becomes both sides of the polarizer which processed the film in which dichroism is shown as a polarizing plate, and which consists of polyvinyl alcohol with a thickness [of an isotropic high refractive index] of 60 micrometers almost optically by dichromatic dye from triacetyl cellulose with a thickness of 50 micrometers was pasted up with acrylic adhesives with a thickness of 20 micrometers. The refractive index n of the polarizer of each polarizing plate is shown in the following table 1. In addition, the standard polarizing plate used Gby NITTO DENKO CORP.1220DU (trade name).
[0030] Each polarizing plate is 41.51% of simple substance permeability, 34.71% of parallel permeability, and 0.03% (wavelength of 550nm) of rectangular permeability.
[0031] The viewing-angle property [light / at the time of using the polarizing plate of this invention as a crossed Nicol drawing 3 -6] of leakage is shown. For drawing 3 , a polarizing plate 1 and drawing 4 are [a polarizing plate 3 and drawing 6 of a polarizing plate 2 and drawing 5] polarizing plates 4, and incident light is 550nm. Drawing 3 - drawing 6 are plotting / (amount [polarizing plate / of this example] of optical leakage) (amount [polarizing plate / standard] of optical leakage) in the shape of a contour line on the basis of a standard polarizing plate. As shown in drawing 7 , a viewing-angle property uses the inclination from the normal of the screen of liquid crystal equipment as the incident angle theta, and expresses the include angle of the circumferencial direction to the normal projected on the screen as an angle of visibility phi. As shown in drawing 8 , the distance from a core shows the incident angle theta, and, as for the graph of a viewing-angle property like drawing 3 - drawing 6 , a hand of cut shows an angle of visibility phi.
[0032] Minimum light leakage rate =(optical ullage of optical ullage / standard polarizing plate of

polarizing plate of this example) x100% of each polarizing plate of this example is shown in the following table 1.

[0033]

[A table 1]

	屈折率 n	最小光漏れ率（入射角）
標準偏光板	1.50	－
偏光板 1	1.51	96 % （ 80° ）
偏光板 2	1.55	88 % （ 80° ）
偏光板 3	1.60	72 % （ 80° ）
偏光板 4	1.70	54 % （ 80° ）
偏光板 5	1.58	83 % （ 80° ）
偏光板 6	1.75	48 % （ 80° ）
偏光板 7	1.65	58 % （ 80° ）

[0034] Moreover, the relation between the refractive index of a polarizer and the minimum light leakage rate is shown in drawing 9 . Thus, as the refractive index of a polarizer becomes large, the effectiveness is more remarkable if substantial effectiveness will show up if optical leakage depressor effect is large and exceeds a refractive index 1.6, and it becomes 1.7 or more.

[0035] Liquid crystal equipment was constituted like the example 1 using the polarizer which has the optically uniaxial anisotropy which processed with iodine the film which consists of polyvinyl alcohol with a thickness of 60 micrometers as a [example 2] polarizer except taking forward Tsunemitsu's refractive-index direction to transparency shaft orientations. Refractive index nx of the transparency shaft orientations of the used polarizer And refractive index ny of absorption shaft orientations It is shown in a table 2. The standard polarizing plate used the same thing as an example 1. Each polarizing plate is 41.51% of simple substance permeability, 34.71% of parallel permeability, and 0.03% (wavelength of 550nm) of rectangular permeability. The viewing-angle property [light / at the time of using each polarizing plate as a crossed Nicol] of leakage is shown in drawing 10 - drawing 13 . In drawing 10 , a polarizing plate 6 and drawing 12 show a polarizing plate 7, and, as for a polarizing plate 5 and drawing 11 , drawing 13 shows a polarizing plate 8. Moreover, the minimum light leakage rate of each polarizing plate is shown in a table 2.

[0036]

[A table 2]

	屈折率 n_x	屈折率 n_y	最小光漏れ率（入射角）
標準偏光板	1.50	1.50	－
偏光板 5	1.51	1.49	80 % （ 80° ）
偏光板 6	1.55	1.45	74 % （ 80° ）
偏光板 7	1.60	1.40	54 % （ 80° ）
偏光板 8	1.70	1.20	35 % （ 80° ）

[0037] Moreover, the viewing-angle property of the contrast of the liquid crystal equipment which used the polarizing plate 8 for drawing 14 is shown. Moreover, the viewing-angle property of the contrast of a standard polarizing plate is shown in drawing 15 as a comparison. When these are compared, it turns out that the field of contrast where drawing 14 is higher spreads out, and the field of contrast 200 spreads greatly especially.

[0038]

[Effect of the Invention] As explained above, by constituting a polarizing plate using the polarizer of a

high refractive index, change of two transparency shaft orientations shaft orientations and a polarizing plate cross at right angles can be compensated, and there can be little optical leakage by the viewing-angle property, and can improve the viewing-angle property of contrast in the liquid crystal equipment using this polarizing plate.

[Translation done.]

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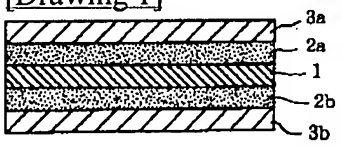
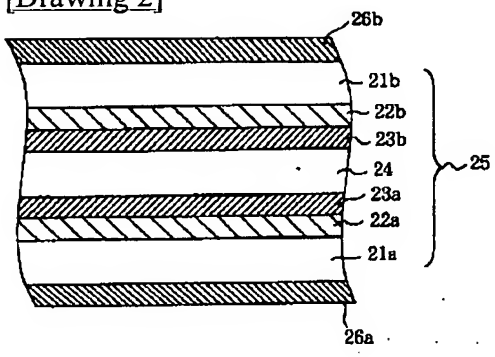
DRAWINGS

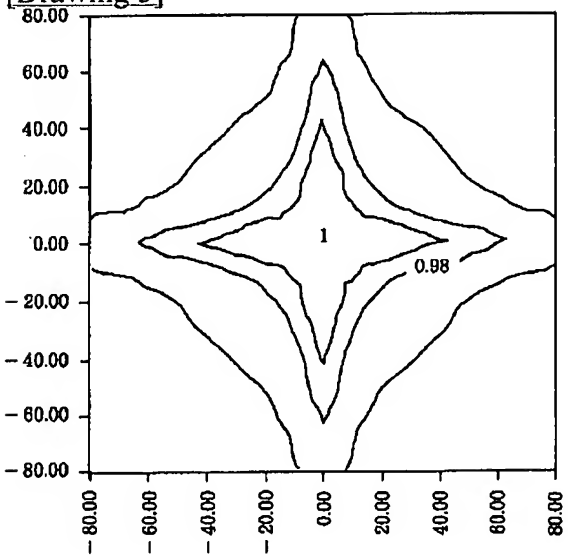
[Drawing 1]



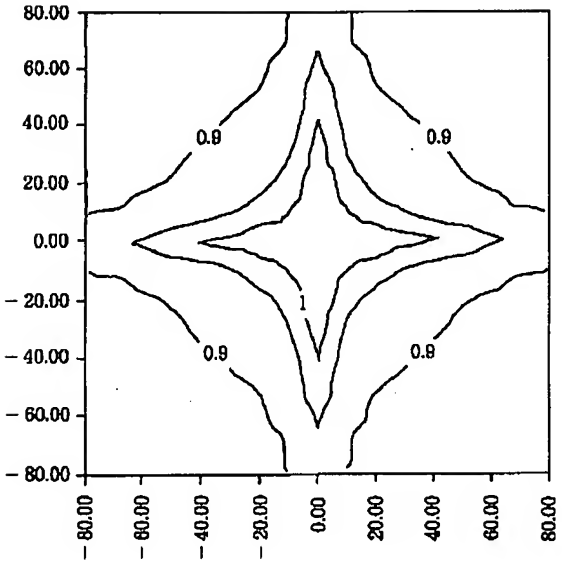
[Drawing 2]



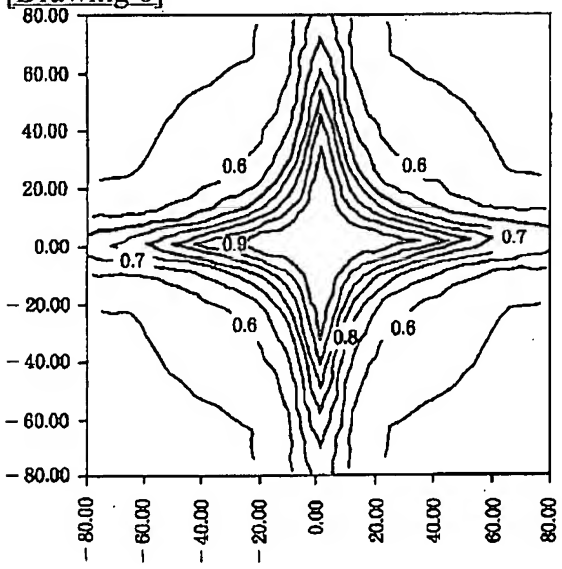
[Drawing 3]



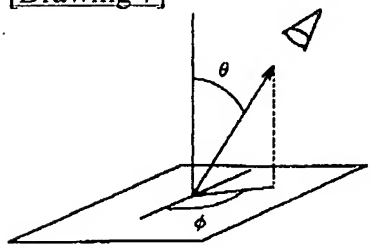
[Drawing 4]



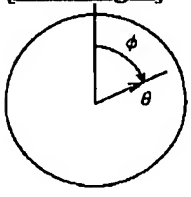
[Drawing 6]



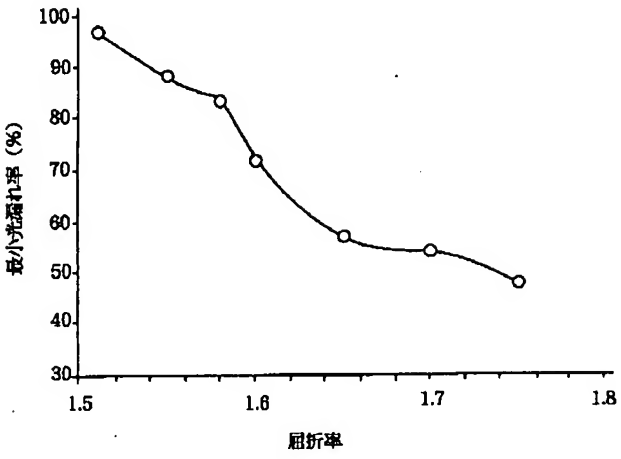
[Drawing 7]



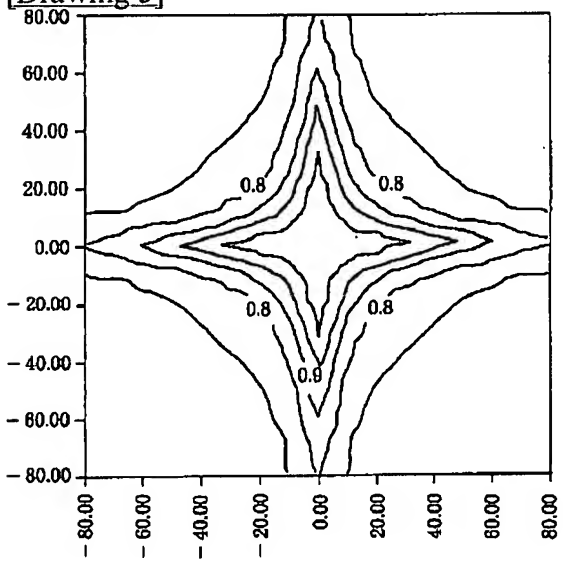
[Drawing 8]



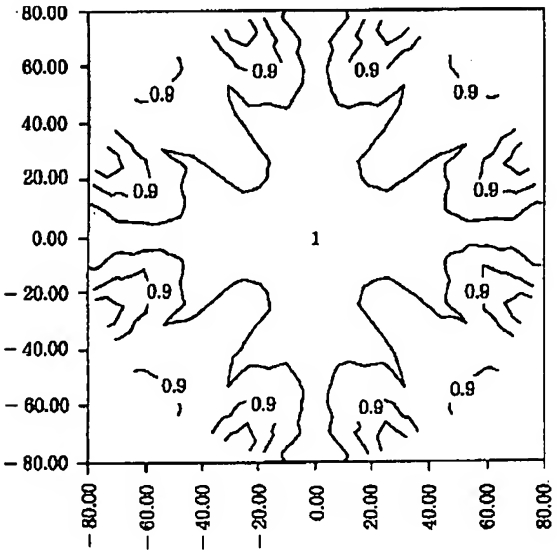
[Drawing 9]



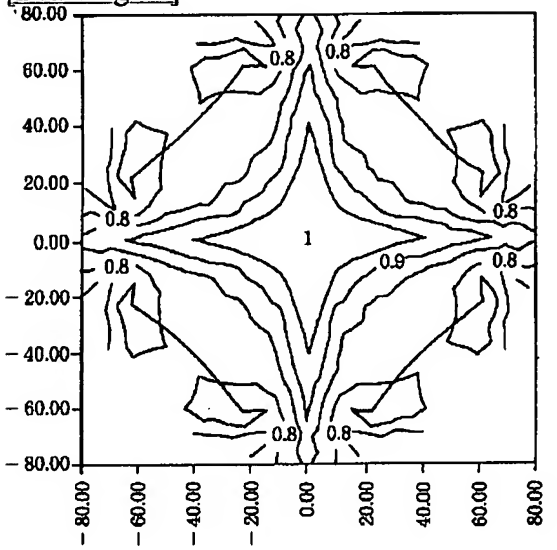
[Drawing 5]



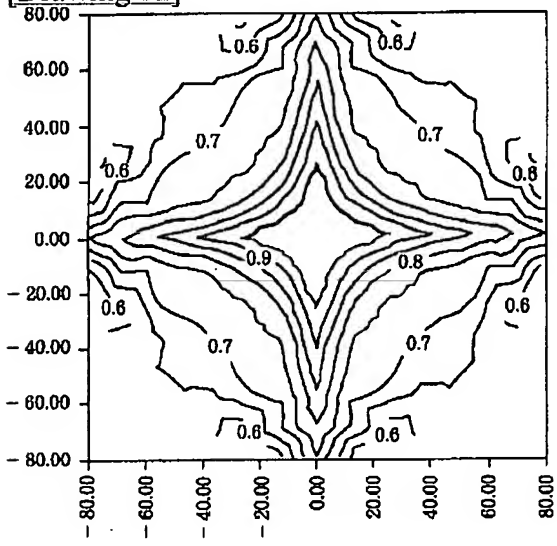
[Drawing 10]



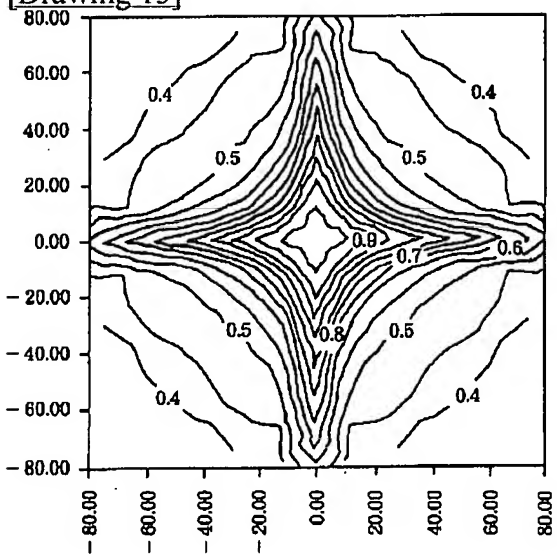
[Drawing 11]



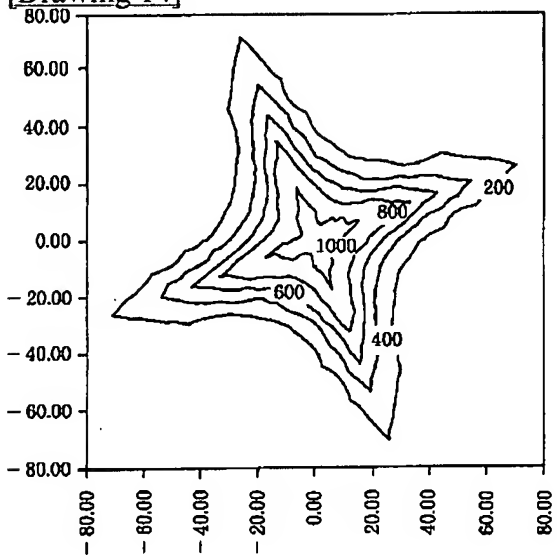
[Drawing 12]



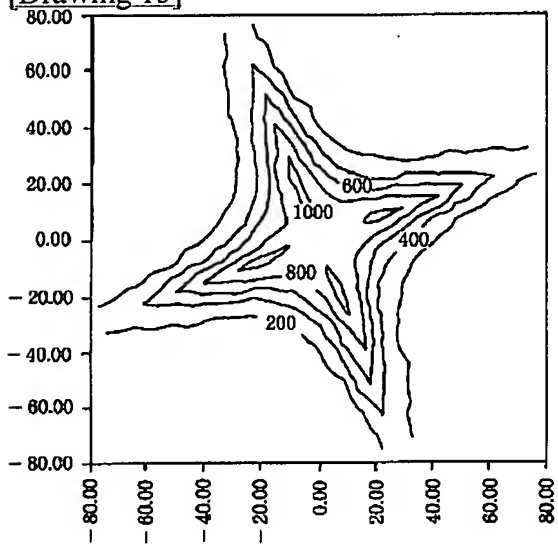
[Drawing 13]



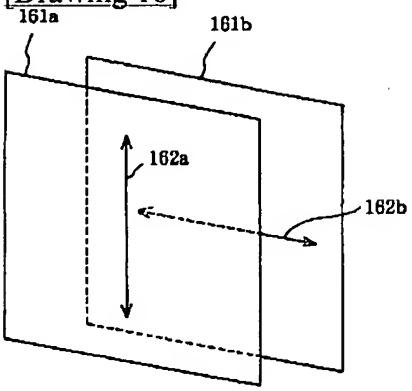
[Drawing 14]



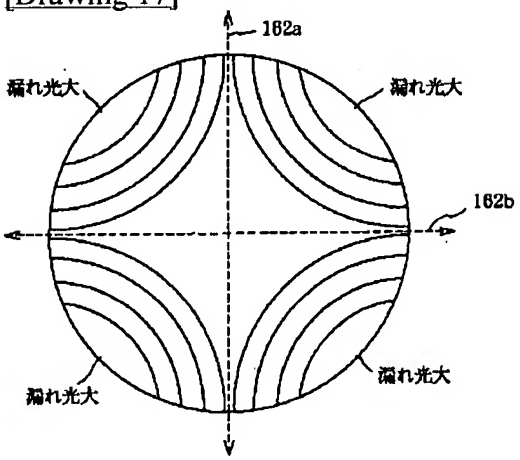
[Drawing 15]



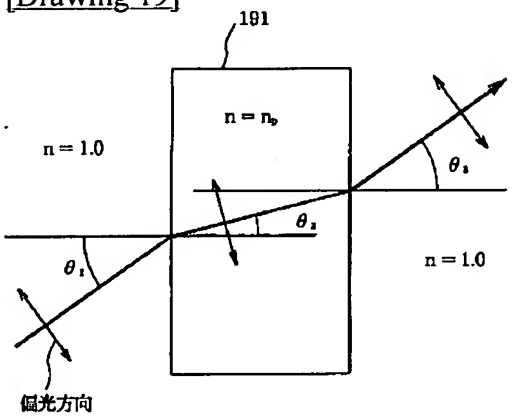
[Drawing 16]



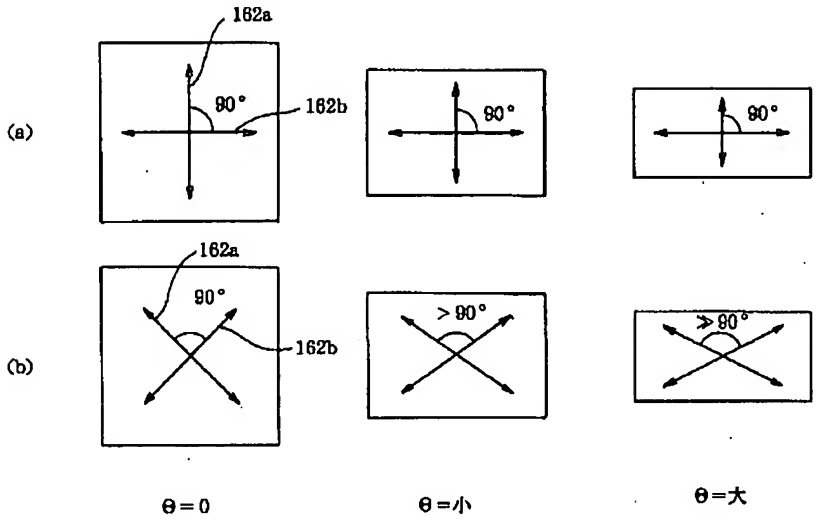
[Drawing 17]



[Drawing 19]



[Drawing 18]



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